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| 09/708,159 | 11/08/2000 | Toshiaki Yasue | JP919990097US1 | 1032 |
| 7590 12/22/2004 | | | EXAMINER | |
| William A Kinnaman Jr IBM Corporation - MS P386 2455 South Road Poughkeepsie, NY 12601 | | | RUTTEN, JAMES D | |
| | | | ART UNIT | PAPER NUMBER |
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DATE MAILED: 12/22/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/708,159

Applicant(s)

YASUE ET AL.

Examiner

J. Derek Rutten

Art Unit

2122

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 09 August 2004.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-4 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-4 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

1. Acknowledgement is made of Applicant's amendment dated 9 August 2004, responding to the 5 May 2004 Office Action provided in the rejection of claims 1-4, wherein claims 1 and 4 have been amended, no claims have been canceled, and no new claims have been added. Claims 1-4 remain pending in the application and have been fully considered by the examiner.

2. Applicant's arguments filed 9 August 2004 have been fully considered but they are not persuasive. Applicant has essentially argued that the O'Brien reference does not disclose moving transfer points to the top of a loop process. However, the cited portion of O'Brien clearly discloses this feature. Further discussion follows in the *Response to Arguments* section below.

3. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Response to Arguments

4. In response to applicant's argument that O'Brien teaches a particular type of loop optimization instead of general optimization (page 5 paragraph 1 of applicant's response dated 9 August 2004), a recitation of the intended use of the claimed invention must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. In a claim drawn to a process of making, the intended use must result in a manipulative difference as compared to the prior art. See *In re Casey*, 152 USPQ 235 (CCPA 1967) and *In re Otto*, 136 USPQ 458, 459 (CCPA 1963).

5. In response to applicant's argument that O'Brien does not teach moving transfer points to the top of a loop process, applicant is referred to the Office action dated 5 May 2004 on page 3 which cites the following text:

In the process of optimizing a computer program, it may be desirable to **relocate a conditional branch instruction to a point outside of its originally containing loop.**

This passage clearly shows moving a transfer point to the top of a loop process. Applicant further points to Fig. 9A as support for this argument. However, in order to make a case regarding Fig. 9A, the supporting text must be considered. Fig. 9A is simply a graphical representation of execution of code depicted in Fig. 6. Review of Fig. 6 shows transfer points at line 150 and line 200. Fig. 7A depicts code after modification of Fig. 6. Supporting text for these figures comes from column 5 line 66 – column 6 line 16, and particularly from column 6 lines 6-10:

In duplicating the loop, the destination of branches in the duplicate loop are modified relative to the beginning of this loop. In line 50 of FIG. 7A, a **conditional branch instruction is placed in the computer program before the code for either loop.**

Clearly, O'Brien teaches moving transfer points to the top of a loop process in Fig. 7A.

6. In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., O'Brien does not make the loop irreducible as argued on page 5 paragraphs 1 and 2 of applicant's response dated 9 August 2004) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

7. Applicant argues on page 5 paragraph 3 that O'Brien does not teach copying code from the top of a loop process to a point that post-dominates the top of the loop process and a transfer point to a location immediately preceding the loop process if the transfer point is located inside the loop process. This argument is based on the allegation that O'Brien does not disclose a transfer point inside the loop process consisting of nodes B-F in Fig. 9A. However, as noted above, Fig. 9A is simply a graphical representation of Fig. 6, which does indeed contain two transfer points at lines 150 and 200. The resulting optimized version of this loop appears in Fig. 7A which shows the results of moving a transfer point to a point that post-dominates the top of a loop process (line 500) and a transfer point to a location immediately preceding the loop process (line 50).

Claim Rejections - 35 USC § 103

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

9. Claims 1-4 are finally rejected under 35 U.S.C. 103(a) as being unpatentable over prior art of record U.S. Patent 5,202,995 to O'Brien (hereinafter referred to as "O'Brien") in view of prior art of record U.S. Patent 6,513,156 to Bak et al. (hereinafter referred to as "Bak"), further in view of prior art of record "Compiler Transformations for High-Performance Computing" by Bacon et al. (hereinafter referred to as "Bacon").

As per claim 1, O'Brien discloses:

A program execution method, comprising the steps of:

moving said one or more transfer points to the top of a loop process if they can be moved there without a problem occurring (column 3 lines 39-41: "In the process of optimizing a computer program, it may be desirable to **relocate a conditional branch instruction** to a point outside of its originally containing loop. This may occur, for example, when a conditional branch instruction demonstrates the property of loop invariance, which is to say, it is evaluated identically regardless of the iteration of the loop. The relocation of such a statement

to a point just prior to loop execution alleviates repetitious, unnecessary evaluations.”);

copying code from the top of the loop process to a point that post-dominates said top of said loop process and said one or more transfer points to a location immediately preceding said loop process if said transfer points are located inside said loop process (column 3 lines 49-53: “In the exemplary embodiment of the invention described below, a loop that has an invariant conditional branch instruction is **transformed into two loops**. The first loop is the original loop. The second loop is an exact copy of the original loop.”);

O’Brien does not expressly disclose: transferring a method from an interpreter process to a compiled code process; storing information for generating recalculation code for specific transfer points; performing a recalculation during a transfer process; or privatization, common sub-expression elimination, and code motion.

However, in an analogous environment, Bak teaches:

transferring, from an interpreter process to a compiled code process, a method that is currently being executed for code that includes a plurality of transfer points at which program execution is transferred from the interpreter process to the compiled code process (column 2 lines 40-45: “the hybrid virtual and native machine instructions may be easily transformed back to the original virtual machine instructions, and the flexibility of compiling only certain portions of a function into native

machine instructions allows for better optimization of the execution of the function”).

storing information for generating recalculation code for one or more specific transfer

points (column 2 line 65 – column 3 line 1: “A copy of a selected virtual

machine instruction at a beginning of the portion of the

function is **stored** and a back pointer to a location of the

selected virtual machine instruction is also stored.”); *and*

performing a recalculation during a transfer process (column 3 lines 1-5: “The

selected virtual machine instruction is overwritten with a

new virtual machine **instruction that specifies execution** of

the native machine instructions so that the function

includes both virtual and native machine instructions.”).

Also in an analogous environment, Bacon teaches:

privatization (page 395 Section 7.1.3: “When a scalar is used within

a loop solely as a scratch variable, each processor can be

given a private copy so the use of the scalar need not

involve any communication.”), *common sub-expression elimination* (page 384

Section 6.7.4: “Common subexpression elimination is an important

transformation and is almost universally performed.”), *and*

moving of code (page 360 Section 6.1.3: “When a computation appears

inside a loop, but its result does not change between

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iterations, the compiler can move that computation outside the loop.”).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use Bacon’s optimizations with Bak’s mixed mode interpreter in O’Brien’s code optimizer. One of ordinary skill would have been motivated to improve object code, particularly code appearing in loops, so that a program will execute in less time. Further, one would have been motivated to transfer the execution of an interpreted loop to natively compiled instructions since native code executes more quickly than interpreted code.

As per claim 2, the above rejection of claim 1 is incorporated. O’Brien does not expressly disclose choosing transfer points for transferring from interpreted mode to compiled mode execution.

However, Bak teaches *defining as a new transfer point, a point from said interpreter process to said compiled code process whereat, when said method that is currently being executed is replaced, the execution speed is increased compared with when said method is not replaced* (column 6 line 61 – column 7 line 5).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use Bak’s selection of transfer points in O’Brien’s code optimizer. One of ordinary skill would have been motivated to improve code so that a program will execute in less time.

As per claim 3, the above rejections of claims 1 and 2 are incorporated. O'Brien does not expressly disclose generating, storing, or employing information for transferring execution from interpreted to compiled execution.

However, Bak teaches:

generating information required to perform a transfer from said interpreter process to said compiled code process (column 7 lines 28-40); and

storing said generated information while correlating said generated information with said transfer points (column 7 lines 28-40 as cited above),

wherein, at said recalculation step, said information stored for said transfer points is employed (column 7 lines 63-67).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use Bak's transfer information with O'Brien's code optimizer. One of ordinary skill would have been motivated to enable the transfer of interpreted execution to natively compiled execution, which is necessarily supported by information regarding the location of code, to increase the speed of a program.

As per claim 4, O'Brien does not expressly disclose a program storage device.

However, Bak teaches the use of a program storage device to hold program instructions (column 4 lines 46-50).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use Bak's program storage device with O'Brien's code optimizer.

One of ordinary skill would have been motivated to store copies of a program on media that enables the distribution of the program to colleagues or customers.

All further limitations have been addressed in the above rejection of claim 1.

Conclusion


10. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. "Generalized Dominators and Post-dominators" by Gupta discusses optimization in the context of directed acyclic graphs.

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to J. Derek Rutten whose telephone number is (571) 272-3703. The examiner can normally be reached on M, T, Th, F 6:00-4:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tuan Q. Dam can be reached on (571) 272-3695. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

jdr


TUAN DAM
SUPERVISORY PATENT EXAMINER